

CLAIMS

1- A device for automated evolutionary assistance to the air traffic control  
5 for equipping an air traffic control system comprising a computer (1) including a software program permitting to receive the data concerning the flight plans (3) of the aircraft(10, 10') and Radars (4) and to elaborate and display (5) them to the controllers (6) of the control sectors (8), the said controllers having a radiotelephony link (6) for communicating with the said  
10 aircraft (10, 10'). The said system moreover comprising means for permitting to the controllers to elaborate and display (12) a list said the "Controller Agenda" of the problems (13) such as the said controllers can forecast them with the sole data and analysis means they have at their disposal,

15 characterized in that the said device comprises ;  
- means (19) for establishing and updating a list of conflicts, said "Computer Agenda" on the basis of all the information and computation means of the computer,  
- means (20) for comparing, aircraft pair by aircraft pair, the Controller  
20 Agenda and the Computer Agenda, in that the said device makes appearing each forecast disparity between the said Agendas  
- means for selecting those of the problems as forecast by the controller which only take their source to the lack of accuracy of the said forecast made by the controller,  
25 - means for selecting among the aircraft pairs those of the conflicts which can be solved by a modification of the flight parameters, and  
- means for exchanging messages between the computer and the controller.

2- A device according to claim 1, characterized in that said device moreover  
30 comprising means for elaborating optimal solutions to the conflicts figuring in the Computer Agenda.

3- A device according to claims 1 or 2 characterized in that said device moreover comprising :

- means for establishing a radio link with the aircraft on board computers
- means for automatically collecting in the said on board computers complementary data for establishing the list of the Computer Agenda, and
- means for elaborating instructions for the collision avoidance of the aircraft.

4- A device according to claim 3, characterized in that said device moreover comprising means for collision avoidance instructions being executed and their execution being monitored by the mean of the automatic data link with the on board computers of the aircraft.

5- A device according to claim 4, characterized in that said device moreover comprising the means for automatically modify, or after the concerned aircraft pilot's agreement, via the data link (16) the flight parameters of the concerned aircraft,

6- A device according to claim 4 or 5, characterized in that said device moreover comprising means for automatically modify, or after the concerned aircraft pilot's agreement via the data link (16) when it is given order by the controller, the flight parameters of an aircraft when the said modifications make the said aircraft trajectory out of its flight plan tolerances,

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7- A device according to one of the foregoing claims, characterized in that said device moreover comprising means for determining among the conflicts of the Controller Agenda list (13) those which have no reason to be and notifying it on display (12) of the sector in charge of the implied aircraft,

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8- A device according to one of the foregoing claims, characterized in that said device moreover comprising means for establishing the list of conflicts

(19) for all the traffic, including the conflicts even before the implied aircraft have entered in the control sector in which the conflict could happen.

9- A device according to claim 8, characterized in that said device moreover  
5 comprising means for selecting in the list of conflicts (19) the particularly sensitive conflicts, namely those which will conduct to conflict clusters being difficult to solve, and means for proposing the modification of the aircraft flight parameters on screen (14) of the assistant controller (7) presently in charge of the aircraft when the said conflict will only occur in a following  
10 sector.

10- A device according to one of claims 8 and 9 characterized in that said device moreover comprising means for selecting in the conflict list (19) the particularly sensitive conflicts, namely those which will give birth to difficult  
15 to solve clusters, and means for proposing, on the screen (14) of an assistant controller, transfer conditions of an aircraft of one of these sectors to the following.

11- A device according to one of claims 8 to 10, characterized in that said  
20 device moreover comprising means for displaying on the assistant controllers screen (14) proposals for anticipated conflict solving namely in the most sensitive cases either for conflicts which will occur in the following sectors, or for coordination between two sectors.

25 12- A device according to one of the foregoing claims, characterized in that said device moreover comprising means for displaying on the screen (12, 14) types of messages from the computer to the controller, on the form of icons (28) in biunivocal relationship with the concerned aircraft pairs, the said icons serving as virtual keyboard for addressing in return messages to  
30 the computer concerning the said conflict.

13- A device according to one of the foregoing claims, characterized in that said device moreover comprising means for displaying on screen (12) for

each conflict of the Controller Agenda, a specific icon the designation of which by the controller makes displaying a virtual keyboard (31) specifically adapted to the situation.

5 14- A device according to one of the foregoing claims, characterized in that said device moreover comprising means for displaying on screen (12) or (14) an icon the designation of which by the controllers or the assistant controllers, indicates their desire to know the solution(s) elaborated by the computer and then to inform the computer of the chosen solution.

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15- A device according to claims 12 to 14, characterized by the fact that set of icons (28) will permit to the controller to delegate, when he or she designates them, the responsibility to the computer.

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16- A device according to one of the foregoing claims, characterized in that said device moreover comprising means for displaying on one of the controllers screen, close to the display of each problem, the time left before the actual conflict and/or the separation at the crossing of the trajectories.

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17- A device according to one of the foregoing claims, characterized in that said device moreover comprising means for displaying on one of the controller screens all the moments of occurrence of the conflicts still to be solved on a time graduated axis.

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18- A device according to one of the claim 17, characterized in that the displaying means of the display of the occurrence moments are such that a controllers can add the moment when they estimate to have to check the state of each problem.

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19- A device according to one of the foregoing claims, characterized in that said device moreover comprising means for elaborating on a screen (SC) a display making appearing each aircraft pair in potential conflict on the form of a point (P) and of its speed vector, the coordinates of the said point

being respectively in abscises the delay between the present moment and the moment when the said aircraft will have a minimum longitudinal separation, and in ordinates their separation distance at this moment.

- 5 20- A device according to one of claims 19, characterized in that said device moreover is arranged for associating to point (P) representing an aircraft pair, a label (E) providing the necessary data concerning the said aircraft.
- 10 21- A device according to one of the foregoing claims, characterized in that said device moreover is arranged for associating to point (P) representing an aircraft pair a indicator (I) giving their vertical separation when their horizontal separation will be minimum.
- 15 22- A device according to one of the foregoing claims, characterized in that said device moreover arranged laid out such as any designation by a controller of an aircraft on any of the screens makes appearing on all the other screens the said aircraft and the aircraft conflicting with it.
- 20 23- A device according to one of the foregoing claims, characterized in that said device moreover comprising means to send control instructions to the on board computers (17) of the so equipped aircraft, and means for receiving from the said computers data confirming the proper execution of the said instructions.
- 25 24- A device according to claim 23, characterized in that said device moreover comprising means for sending a message to the so equipped two conflicting aircraft for sub-delegating to them of the responsibility of insuring their safe separation by their own means.
- 30 25- A device according to one of the foregoing claims and claim 15, characterized in that said device moreover comprising means for insuring the automatic display of any so delegated conflict, so that the Controller

Agenda provides to the controller a permanent monitoring board displaying a list of the delegated conflicts and a list of the conflicts still to be solved.

26- An automated process for evolutionary assistance to air traffic control  
5 performed in an air traffic control system comprising a computer programmed for:

- receiving data concerning aircraft flight plans (3) and Radars (4) and elaborating and displaying them (5) to controllers (6) of a control sector (8), the said controllers having a radiotelephony link (9) for communicating  
10 with the said aircraft (10), and

- elaborating and displaying a list, said the "Controller Agenda" (12), of the conflicts (13) such as the said controllers can forecast them with the sole data and analysis means they can have access to,  
characterized in that the process comprises :

15 - an establishment and updating of a list of conflicts (19) said the "Computer Agenda" on the basis of all the data and computing means available to the computer,

- a comparison, pair of aircraft by pair of aircraft, of the Controller Agenda and the Computer Agenda, such as to make appearing the forecast  
20 disparities between the two said Agendas,

- a selection of those of the problems retain by the controllers which only results from the lack of accuracy of the forecast as made by the said controllers, and

- a selection among the retained problems of those which can be solved by  
25 a slight modification of the flights parameters.

27- A process according to claim 26, characterized in that said device moreover comprising means for elaboration of optimal solutions to the conflicts of the Computer Agenda.

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28- A process according to claim 27, characterized in that said device moreover comprising:

- a link between the ground and the aircraft computers for constituting, by an action being subliminal to the controllers and the pilots, an "automatic air traffic control pilot"
- exchanges of messages between the computer and the controllers

5 (6) having the screens (5) as a basis, and

- the elaboration and performing of conflict avoidance of the aircraft via the said data link (16) between the ground and aircraft airborne computers (17).